§ 163. **Separation of sexes in trees.**—Mr. Darwin has called attention to the fact that trees have a strong tendency to bear flowers with separated sexes (*Orig. Spec.*, Chap. IV., *Cross and Self Fert.*, Chap. X.). He finds that about 60 per cent. of the native trees and bushes of Great Britain are diclinous, "an enormous proportion compared with other British plants." From Dr. Hooker it appears that in New Zealand 48 per cent. of the trees and 41 per cent. of the bushes have this character, but only 26½ per cent. of other plants. Dr. Gray's authority is given for the statement that out of 132 trees, native to the United States, 95 or 72 per cent. are more or less diclinous, for the most part decidedly so. As Dr. Gray has evidently limited himself to the taller trees, the 419 "trees which usually attain a height of 16 feet or more" in Dr. Vasey's catalogue were considered from this point of view. It was estimated that 268 or 64 per cent. were more or less diclinous. This result compared with that of Dr. Gray and that of Dr. Hooker shows that the bushes diminish the percentage, or in other words that the higher the trees the more likely they are to be diclinous. In Gray's Manual there are enumerated 2562 flowering plants; of these 493 or 19¼ per cent. may be said to be diclinous. Of trees, shrubs, and woody-climbers which usually attain the height of at least six feet there are 292, and 169 of these, or about 58 per cent., are diclinous. If there were no tendency of woody plants this way there should be only 19¼ per cent., or 56 instead of 169 diclinous. As in this calculation there are included bushes only six feet high, the lower percentage, 58, seems to confirm the rule, that the higher the tree the greater the probability of its sexes being separated.

But it is only a rule subject to exceptions and not a law. The Australian Gum-tree, said to be the tallest of trees, does not appear to be diclinous, and in fact Dr. Hooker says the rule does not hold good in Australia at all. Nor does the converse of the proposition, the more diclinous plants the more trees, hold in reference to the Endogens in Gray's Manual. There are found (in that class) 711 species of the 2562 flowering plants. A simple proportion gives 81 for the number of trees to be expected among Endogens out of the total of 292. But as 205 of the 493 diclinous plants are Endogens, that is about 41½ per cent., and there are 169 diclinous trees in all, about 70 would be the very least number to be expected. In fact there are not 81 nor 70 but only 8 endogenous trees, all diclinous, it is true, but such insignificant representatives of trees as the 8 woody *Smilaces*.

It seems to be now pretty well settled that the pollen is conveyed from the anther to the stigma chiefly through two agencies, the wind and insects. This must be especially the case with diclinous plants. If the flowers are to attract insects, they must do so by putting up a sign that they have honey and pollen to dispose of. The signs which insects read are color and odor. If, on the other hand, fertilization depends upon the wind, there must be an over supply of pollen, and a crowd of recipients with prominent stigmas to secure the continu-

ation of the species, but attractive colors and odors are not needed. Writers on the subject distinguish the former as *entomophilous*, the latter as *anemophilous* plants.

To apply these observations, let the Exogens in Vasey's list of trees and in Gray's Manual be divided into two sections, the second section in each beginning with Oleaceæ. In general the orders in the first section are marked by flowers attractive to insects ; in the second, by anemophilous flowers. Vasey has 413 exogenous trees—202 of these precede Oleaceæ, or nearly one-half. But this first section, the section of entomophilous plants, comprises only 60 of the 264 diclinous exogens, the remaining 204 being anemophilous. Of the species in Gray's Manual there are 1593 before Oleaceæ with 51 diclinous trees; the remaining exogens are only 258 with 110 diclinous trees —an enormous disproportion. These 110 diclinous trees are mostly comprised in 8 orders, viz., Oleaceæ, Lauraceæ, Urticaceæ, Juglandaceæ, Cupuliferæ, Betulaceæ, Salicaceæ, Coniferæ. In these orders are found most of our forest trees, with large stigmas, abundant pollen, numerous individuals, social in habit, and rearing their heads to the sky to catch the breezes so necessary for their fertilization.

Whether anemophilous trees have acquired their height and their firm fibre in consequence of their diclinous flowers, or their floral character from their other habits, is a question. Mr. Darwin inclines to the first view. It is not, however, necessary for wind fertilized plants to be tall or woody; all that is needed is that the wind should have a free passage from one to the other, an end which would be equally secured by having the plants social, about the same height and free from interposing strangers, as we may see in the waste places covered with *Ambrosia trifida*, or other species of this anemophilous genus. But a more interesting example is furnished by the prairies covered with grass and the marshy flats with sedges. Reference has before been made to the large proportion of diclinous plants among Endogens, and the small proportion of woody species. The two large orders we are speaking of are mostly wind fertilized, and moreover well adapted to grow where woody plants will not, as Prof. J. D. Whitney has shown in his articles on the prairies in Vol. X. of the *American Naturalist*. They had no need, therefore, to become woody, and no power, in such soils. Their social habits, moreover, secure them to a great degree from other herbaceous rivals.

Mr. Darwin is of opinion that plants were originally diclinous, and that the insect-fertilized trees and shrubs have become monoclinous after the appearance of insects. Perhaps they were outstripped in growth by the others and could only survive by means of other adaptations. In general they are more lowly than the diclinous, though there are some remarkable exceptions—Eucalyptus and some Leguminosæ for example. The Salices present an intermediate stage, for the Willows, which are for the most part low, are visited by insects, while their taller relatives, the Poplars, are wind fertilized. The woody climbers and the mistletoes seem to have preserved their original separate flowers by having at an early epoch availed themselves of the height of their neighbors.

Anemophilous plants are generally biennial or perennial, and also

monoecious. The wind is so uncertain an agent, that species which had this two-fold security would be more likely to survive. Very few are annual. Ambrosia, mentioned before, is a remarkable exception, but then the staminate are so arranged in reference to the pistillate flowers that self-fertilization appears to be pretty certain.

W. H. L.

§ 164. **Townsendia.**—Among the many interesting specimens sent by Dr. T. E. Wilcox, U. S. A., collected at Camp Supply, in the Indian Territory, I find the following which seems to be new:

Townsendia Wilcoxiana.—Acaulis; foliis radicalibus spatulatis acutis hispidulis 1–1½ policaribus; *capitulo* magno, *solitario* (rarius duobus) radicali sessili; invol. bracteis linearibus subacutis subequalibus, disco brevioribus, ciliatis, vix purpureis; radiis flor. masc. uniseriatis purpureis linearibus *planis* erectis, disco duplo longioribus (1′); disci flor. fem. tubulatis luteis cum *dentibus* 5 *atro-fuscis; pappo* in *radio et disco conformi*, setibus ad 30 albis, disci longitudine.

Resembles in habit *T. sericea*, the original species, but differs specifically in the characters italicised above. All my specimens are with but one head, but there are specimens in the herbarium of Columbia College (confounded with those of T. sericea) which show a tendency to form two heads or a double head. A. Wood.

§ 165. **Borago.**—This is the spelling of the word we find in Linnæus, but of late years the double *r* has come into use. This change appears to have originated among the botanists on the continent of Europe, and to have gradually made its way into England and to this side of the Atlantic. Whatever the origin of the word, it seems to obtain in some form among both the Latin and Germanic nations, among the latter, however, more frequently with one *r*. As the double *r* is now adopted by so many eminent authorities, it seems advisable to abandon the Linnæan spelling, and write Borrago, Borraginaceae, though we shall hardly change the English word Borage. It is curious to notice how little reliance can be placed upon spelling in a quotation. For we find Lindley, for example, quoting Tournefort, in his index, for Borrago, but in his list of genera, Borago.

§ 166. **Lechea.**—In Bentham & Hooker's Genera, at the close of the character of the order *Cistineæ*, occurs the following:

"FORMAE ABNORMES."

"Flores dimorphi, alii apetali oligandri in *Helianthemis* nounullis "et interdum in Lechea.

"Stamina interdum pauca, imo petalis pauciora in *Lechea* et in "*Helianthemis* quibusdam."

The two forms of flower in Helianthemum Canadense are well known, and Linnæus himself mistook a form of this Helianthemum for a Lechea, but I do not find any American authority for the statement that Lechea has sometimes dimorphous flowers, and presume that Dunal in the Prodromus is the source from which Bentham and Hooker drew, but have not that work at hand. According to Rafinesque the flowers of Lechea are only open in the middle of the day. I have seldom seen them open, but have examined very many of different species when dried, and have never observed any ten-